Canadian Conservation Institute
Institut canadien de conservation

CCI Notes 4/3

Conservation of Wet Faunal Remains: Bone, Antler, and Ivory

Caution:
This Note discusses actions that will physically affect the object, and/or procedures that involve the use of chemicals. Exercise caution, and seek qualified assistance if in doubt.

Introduction

Faunal remains are often damp or wet when first excavated, and must be dried before they can be studied or stored in a research collection. Undeteriorated specimens of bone, antler, and ivory can be treated by a non-specialist, but deteriorated specimens may require the advice of a conservator. This Note discusses ways to assess the condition of bone,[1] and outlines procedures to preserve these materials.

Assessing the Specimens

First determine whether the material is bone, antler, or ivory (see CCI Notes 6/1 *Care of Ivory, Bone, Horn and Antler*). Ivory, which has multiple layers, is more dense than bone or antler and is more likely to crack or delaminate while drying.

Next determine the condition of the material. One good indication of condition is the hardness of the surface. To test hardness, gently press the surface of the bone in several areas. If it compresses or feels spongy, the material has deteriorated. Deterioration can be roughly divided into three categories: a hard surface indicates little or no deterioration; a soft surface with hard bone beneath indicates slight to moderate deterioration; and an extremely soft surface indicates a high degree of deterioration. In the latter case, it may be necessary to consolidate the material prior to drying.

Bone that is hard or has only a slight softening of the surface can probably be air-dried safely, but bone that is soft is likely to be sensitive to water loss. However, hardness is only one indication of condition. Some burial conditions selectively damage one or more components of bone, leaving an object that is hard but still susceptible to damage (e.g. shrinkage, twisting, cracking, or delamination) when air-dried. Therefore, even if a bone is hard and apparently durable, test dry a few pieces. If any problems are noted, a decision can then be made about consolidating the other pieces.

Before drying, note areas of damage and measure any large cracks. Repeat these measurements occasionally throughout the drying process, as colour changes during drying may make the cracks appear larger.

Cleaning

Note: These water-based treatments are for damp or wet bone; dry bone, such as surface finds or pieces from hot-climate excavations, should never be re-wetted without the advice of a conservator.

Archaeological remains are generally covered with dirt, and are often penetrated by the roots of small plants. To remove dirt, briefly rinse the object in water. Bone in good condition can be immersed for a few minutes, but should never be left to soak. Do not use detergents as they may contain colorants, perfumes, and other additives that might contaminate the bone, rendering it useless for chemical analysis or dating. Stubborn dirt deposits can be gently dislodged with a paintbrush or wooden probe, but do this cautiously as wet bone can be soft and easily abraded. Rootlets growing in the bone can sometimes be removed with tweezers. However, take care not to pull fragments of bone

off with the rootlets, which are often branched beneath the surface. To prevent this, cut the rootlets off at the surface with fine scissors. Note that dirt and rootlets are not harmful if left in situ, so always consult an archaeologist about the degree of cleaning required.

Bones retrieved from middens may occasionally be coated with excessive amounts of animal fat. Permafrost on Arctic sites provides excellent conditions for the preservation of fats and oils from sea mammals, but once the artifact is excavated this fat may go rancid and pose a health hazard if it is not removed. To determine the appropriate treatment, consult a conservator.

Excavated bone is often stained with tannins and metal corrosion products. As these stains will generally not cause further damage to the structure of the bone, and most faunal material is used for research collections rather than for display, staining is not a major concern. However, if stain removal is necessary, consult a conservator before commencing. Many of the acids, bleaches, or chelating agents used to remove stains can damage bone.

Skeletal material from saltwater environments will have absorbed the chlorides, nitrates, and sulphates that are dissolved in the water. These soluble salts must be removed before the material is dried or they will form salt crystals that can physically destroy the structure of the bone. Even if this damage is not visible immediately after drying, changes in humidity levels over the years will cause the continual solubilization and re-crystallization of the salt until cracks form in the bone. A white effluorescence is evidence of contamination by soluble salts. To remove salts, soak the bone in successive baths of fresh tap water. Monitor each bath for traces of soluble salts with a conductivity meter to determine when the salts have been removed, i.e. continue monitoring until a reading smaller than the error rate of the instrument is achieved. Other test methods (chloride-ion electrodes, test papers, silver/nitrate or ion-specific titrations) are also available for determining the chloride content.

Insoluble salts are characterized by hard white concretions on the surface of the bone. Unlike soluble salts, these substances are inert and can generally be left on the bone. However, if they are obscuring details, they can be removed by a conservator. Note that removal should be done while the bone is still wet as drying hardens the concretions and makes their removal more difficult.

Consolidation

The decision to consolidate must be considered carefully, as consolidants can interfere with the chemical analysis or dating of the bone. It may be preferable to allow minor cracking to take place rather than to limit future analysis. If the material is to be consolidated, some samples should probably be left untreated to provide uncontaminated material for testing.

Consolidation should be undertaken only by a conservator or with the advice of a conservator. Any cleaning or salt or stain removal that is necessary must be conducted first. Consolidants may be water- or solvent-based. It is important decide which type to use before drying commences as water-based consolidants must be applied while the bone is still wet.

Drying

Material that is in good or only slightly deteriorated condition can usually be dried without problems. Air-drying is the simplest method, although the evaporation of water can create enormous stresses in the structure. Because bone responds to changes in relative humidity by expanding and contracting to different degrees in three different dimensions — longitudinal, radial, and tangential — even undeteriorated bone can crack while drying. During the drying process, the outer surfaces tend to dry first and contract around the still damp, expanded interior. This can cause large areas to shrink, crack, or warp if the bone structure has been weakened through deterioration. Exposed areas of cancellous or less dense bone will also dry faster than thicker, compact bone, again leading to areas of stress. Ivory, because of its dense laminated structure, is more prone to splitting than bone or antler, and should be watched more closely during drying.

Air-drying should be slow and controlled. The simplest method is to lay the clean wet bone on a table or an open mesh rack, and allow it to dry slowly. Turn bones frequently to ensure even drying, and monitor all pieces for the appearance of cracks, delamination, or other physical changes. The development of new cracks or enlargement of existing cracks is an indication that the bone is drying too quickly. If this is the case, cover the bone with a polythethylene sheet to reduce the rate of evaporation.

Bone should be dried at moderate humidity and cool temperature, out of sunlight, and away from any heat sources. The rate at which the bone dries can be slowed

by increasing the relative humidity. This can be accomplished by reducing the temperature (place the object in a refrigerator or a cool basement room) or by increasing the relative humidity in the vicinity of the bone (hang wet cloths over the drying racks or add room humidifiers).

Deteriorated bone may respond poorly to air-drying. If cracking occurs when test samples are dried, the bone may require consolidation or de-watering prior to drying. Water can be removed from bone by immersing it in several baths of increasing concentration of a polar solvent such as ethyl alcohol. The lower surface tension of the solvent relative to water decreases the drying stresses created by evaporation. However, most solvents are toxic, flammable, and pose severe risks if handled without proper ventilation, safety equipment, and hazardous waste disposal. Therefore, immersions in solvents should not be attempted by a non-specialist.

The drying process can be monitored by weighing the object on a regular basis, usually daily or twice per week. There should be a slow, steady decrease in weight that tapers off until there is no measurable change, at which point the bone can be considered dry.

Wet bone is very susceptible to mould growth, particularly in high relative humidity (over 65%), warm temperatures, and stagnant air. It is therefore important to check the bone regularly throughout the drying process. Mould on bone is usually characterized by white fluffy strands on the surface or fine hairs bridging the cavities of the bone. If mould is found, carefully wipe the fungal growth off with a damp paintbrush. Try to lift the filaments off the surface and out of the cavities. Rinse the brush frequently to avoid re-contaminating the surface. After cleaning, spray the surface lightly with isopropyl alcohol (rubbing alcohol, at least 30% v/v in water) to kill the remaining spores. Note that mould spores are difficult to kill, so watch the object carefully for new outbreaks. Also be sure to disinfect any materials that have been in contact with the object. Clean the brush with soap and water and dip it in isopropyl alcohol before using it again.

Documentation

Documentation of the treatment of faunal remains is often sparse or non-existent. However, new developments and the increasing importance of analysis for research of this material make the recording of specific treatments very important. Therefore, record any detergent, solvent, consolidant, or other chemical that is applied to faunal remains and add this information to the archaeological record. This will alert researchers to possible interference from these materials during future testing.

Conclusion

This Note provides broad guidelines for cleaning and drying bone, antler, and ivory. Most bone can be safely treated with minimal intervention provided the material is assessed and selected carefully, and the cleaning and drying process is monitored. For more complex treatments involving the use of detergents, consolidants, chemicals, or solvents, consult a conservator.

Footnote

1. The term bone is used to imply all faunal remains (bone/antler/ivory) unless the specific material is named.

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Originally published 2002
Revised 2007

Copies are also available in French.
Texte également publié en version française.

Cat. No. NM95-57/4-3-2007E
ISSN 0714-6221

Printed in Canada